Technical Report

Initial Survey Results: Tidelands Recovery at Bremerton's Buried Pipelines: East Beach Main Replacement and Washington Ave Main Abandoned

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Summary

The Washington Department of Natural Resources is challenged with finding a sustainable balance among water dependent uses, public access, and environmental protection of state-owned aquatic lands. When a lease is vacated, DNR usually requires the tenant to remove any tenant-owned improvements. In some cases there is a question whether the removal of tenant-owned improvements will create additional, longer term disturbance as opposed to leaving the abandoned improvements in place. DNR has agreed to allow a decommissioned, buried pipe (the tenant-owned improvement) be capped and remain at a vacated lease site. However, off-site monitoring for tideland recovery at a different recently installed pipe will be considered as a proxy to determine whether impacts from dredging the decommissioned pipe are acceptable, and pipe removal is preferred over leaving the buried, capped pipe in place on the public tidelands.

Introduction

The purpose for this monitoring is to assess whether the dredging and removal of a sewer main pipe would cause such significant long-term disturbance of the habitat that leaving the buried, decommissioned pipe in place should be considered. To evaluate this, an agreement between WDNR and the tenant to have DNR Aquatics scientists develop an off-site monitoring plan to assess recovery of benthic habitat following a project that involved similar dredging for installation of a new sewer main on the "East Beach Main " (EBM) (DNR Aquatic Lands Easement 51-089890). The monitoring described below is required as part Exhibit B, Section 2B "Additional Obligations: Off-Site Monitoring" of Easement No. 51-092390 "Washington Ave Beach Main"(WBM). The agreement is to allow the decommissioned on-site WBM pipe (#51-092390) to remain in place, with limited construction to cap the pipe and remove concrete anchors, unless off-monitoring indicates pipe removal is preferred.

To properly assess disturbance and determine a recovery trajectory, a Before After-Control-Impact design is most applicable. However, the off-site sewer main (EBM) that will be monitored as a proxy to the decommissioned pipe was installed more than two years (July-August 2013) before this initial monitoring (October 2015). A 'before' survey is therefore not possible. Additionally, it proved difficult to identify 'true' control sites as both the abandoned and installed pipes were located in areas experiencing a variety of disturbances. The study design included paired surveys of environmental parameters at the two sites: the installed sewer main site EBM construction, and the decommissioned unremoved sewer main site "West Beach Main" (WBM) construction and nearby control. The null-hypothesis predicts no significant differences will exist between the sites, and no difference will be detected in any proceeding surveys. If a significant difference is detected after the first survey, further surveys will be required to determine whether there is a trend toward convergence. If no significant differences are detected between the two sites, recovery since the time of installation will be assumed satisfactory. If no significant differences between the sites are detected, any deviation in the recovery trajectory, or exposure of the decommissioned pipe at the beach surface can be detected through long-term yet reduced monitoring.

Objectives

Compare environmental parameters at the off-site installed pipe (EBM) and the abandoned pipeline (WBM) for indications of tidelands ecological recovery.
Environmental parameters measured include:

- Bathymetry and sediment characteristics
- Submerged aquatic vegetation abundance and distribution
- Benthic invertebrates abundance and diversity

Background and Methods

Site description

Study sites are located within the Bainbridge Basin at the Washington Narrows waterway. The study area is considered to be an area of degraded habitat (NOAA 2010). Natural physical processes and anthropogenic impacts likely contribute to habitat conditions. Relatively narrow channel width (350-370m at mllw), high currents (~2.2 knots), and course sand to coble substrate characterize the narrows as a high-energy sediment transport zone (NOAA 2010). Anthropogenic habitat degradation include shoreline armoring, and degraded quality impacts (NOAA 2010). Sinclair and Dyes, waterbodies connected by the narrows are on the 303(d) list for exceeding Total Maximum daily load values (TMDL)(Ecology). However, the area is considered critical habitat for the Puget Sound Chinook, an evolutionary significant unit, and is used by Coho, chum and Steelhead).

Construction:pipe installation and pipe decommissioning

The EBM construction project occurred between July 2013 and August 2013. The project consisted of installing 3000 linear feet of a 24" high-density polyethylene pipe to replace the function of a 20" asbestos cement pipe. A 3 to 7ft wide trench was dug, the amount of material excavated and back filled was estimated at 4,400cy, with an additional 200cy added to the excavation area. The WBM construction project occurred in the summer of 2015. The project consisted of decommissioning and capping a 6" sewer main by installing a gravity sewer on top of the bluffs at street level. Sanitary laterals and concrete anchors were removed from the pipe. Lateral lines were cut at 2 feet below grade and capped with cement. An estimated 15cy of material were excavated and backfilled and an additional 5cy of material were added; thirty tons of piping and concrete block were removed.

Field sampling and data processing

The EBM and WBM pipe sites are located on opposite shorelines of the narrows (Figure 1). Data collections consisted of beach slope/bathymetry, macroalgae composition, substrate grain size, total organic carbon (TOC), and beach infauna composition. We established 15 transects, spaced 50m apart, at each of the four sites (EBM construction, EBM control, WBM construction, and WBM control). The EBM control site was split due to lack of similarly sized comparable habitat on either side of the effect area.

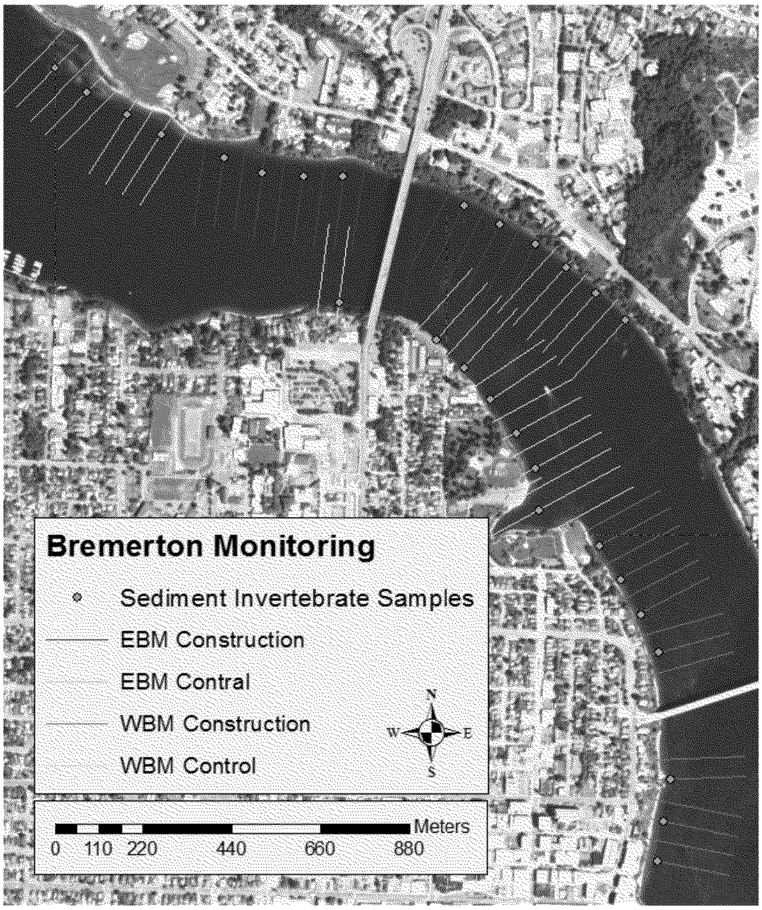

Figure 1 Sample sites

Fieldwork was conducted October 2015 and follow-up sediment sampling occurred in October 2016. Sampling in 2015 was conducted from a 20ft research vessel, sampling in 2016 was conducted from a 14ft inflatable. A Trimble Pro 6H GNSS receiver record time and position (sub-meter horizontal actuary) for each data point. A BioSonics echosounder collected hydroacoustic bathymetry data (10 pings per second) and a towed underwater video camera recorded video data to determine macroalgae composition. Sediment, TOC and invertebrate samples were collected in the intertidal, along alternate transects, to depths of 5cm, using a 1 liter stainless steel scoop.

Hydroacoustic data was processed using BioSonics Visual Acquisition software. Depth data were corrected to MLLW and position data were differentially corrected to sub ≤15cm horizontal accuracy. To compare bathymetry and slope values across sites transects lengths were standardized to a 40m length, starting at the 0m MLLW depth contour. Video data were reviewed to identify macroalgae presence per second of video. Eelgrass, green, red, brown (genus) and kelp (genus) were tabulated. Invertebrate samples were sorted in the field, preserved in 80% ethanol, and classified in the lab to lowest practical taxon (LPT). Invertabrate abundance, number of taxa, richness, and Shannon diversity were calculated. Sediment samples were frozen and will be processed and grain size.

Differences between average depth, and slope were assessed using ANOVA. A Spearman's rank-order pairwise correlation was used to determine associations between invertebrate community metrics and habitat variables (Zar 1999).

Results and Analysis

Bathymetry and Sediment

Bathymetry data are presented in Table 1. The beach shape and elevation were similar among sites. Average depth ranged from 2.2m to 2.9m across sites. Both control sites had slightly higher variance reflecting some morphologic complexity across the sites. Slope were found to be significantly different between sites the paired construction and control sites ($F(3,15)=3.39$, $p=0.024$)- without any before data it is impossible to know whether this difference is a result of construction or natural variability between east and west banks of the straits. WBM control was the only site with average slope values less than 10%. Sediment sample processing has not been completed, though from visual inspection of bottom grab samples in 2015 and 2016, a coarse gravelly-sand mix dominated at all sites. This gravel-sand mixture is anticipated at these hydrologically dynamic beaches. Total organic content will likely be low with any difference among sites within the natural variability. Sediment results will be updated as the data becomes available.

Table 1 Average depth and slope along EBM, WBM and control sites No sig diff @ p=0.024

Site	Ave Depth (m) MLLW	Ave Slope*
EBM Construction	2.7 ± 0.6	11.4 ± 0.0
EBM Control	2.2 ± 2.5	10.4 ± 0.5
WBM Construction	2.9 ± 0.6	13.9 ± 0.1
WBM Control	2.6 ± 2.0	8.8 ± 0.2

Macroalgae

Video data were collected from depth of 5m MLLW to just above the 0m MLLW contour. Green and red algae were present throughout the surveyed area. Only one individual unidentifiable prostrate kelp stipe was observed in a single camera frame on the East Bank. Macroalgae density reported as estimated percent cover was similar at EBM, WBM and control sites. Though submerged aquatic beds of native seagrass and kelp were not present, the macroalgae present may serve as forage fish spawn substrate.

Benthic Invertebrates

Community metrics are presented in Table 2. The total number of organisms, Number of LPT taxa The number of organisms collected, LPT species count, species richness, and Shannon diversity numbers are within a comparable range. Pielou evenness closely approaches 1.0 (the maximum possible score). Evenness results are likely due to low abundance of organism present. Crustaceans dominated invertebrate communities. Shore crab was the most abundant organism found at each site. Shifts in invertebrate diversity indicative of disturbance such as an increased abundances of nemerteans a decrease in common bivalves or polycheates were not observed.

Table 2 Invertebrate abundance and diversity

	EBM Construction	EBM control	WBM Construction	WBM control
Total # of Organisms	59	37	62	77
# taxa	14	17	14	17
Richness	3.19	4.43	3.15	3.68
Shannon diversity	1.67	2.57	2.03	1.61
Pielou evenness	0.63	0.91	0.77	0.57
% crustacea	71%	60%	85%	88%

Table 3 Major benthic invertebrate taxonomical groups

	EBM Construction	EBM control	WBM Construction	WBM control
Annelida	*6*	*9*	*3*	*6*
Blood worm	0	1	3	0
Ragworm	1	2	0	1
Worms	5	6	0	5
Crustacea	*42*	*22*	*53*	*68*
Amphipod	4	5	19	11
Black-eyed hermit crab	0	0	4	0
Cleaner Shrimp	0	1	0	0
Grainyhand hermit crab	2	0	0	8
Hermit crab	0	0	0	1
Isopod	2	4	5	1
Shore crab	34	8	24	46
Shrimp	0	1	1	0
Soft bodied crab	0	0	0	1
Zooplankton	0	3	0	0
Mollusca	*11*	*6*	*6*	*3*
Bivalve	0	1	0	1
Blue top snail	1	0	0	0
Limpet snail	7	0	0	2
Periwinkles snail	3	5	5	0
Unidentified Snail	0	0	1	0

Discussion

Results from comparison of multiple environmental parameters at the 2013 installed pipe, at the decommissioned pipe, and the control sites reveal no significant differences. Observations from DNR staff immediately post-construction indicated very obvious disturbance including muddy, soft substrate at the pipe installation site ((b) (6) personal communication). It appears there has been recovery of the bed and tidelands. These beaches and nearshore areas along the straits are exposed to strong currents and wind waves which would quickly winnow out any fine substrate.

This Bainbridge basin/Washington straits area is fairly developed. Another way to interpret the results is to recognize both constructions sites and the control sites are all exposed to some anthropogenic disturbances so they are all in some state of recovery in response to various disturbances. It is possible to measure only relative extent and rate of habitat recovery when the initial baseline is unknown and undisturbed control sites are not available.

Suggested Next Steps

- Update report with sediment data as available
- Implement a reduced sample design that includes annual sediment collection, and bi-annual aquatic vegetation surveys.
- Compare differences among sites and over time to determine if the system is recovering, remaining stable or declining.
- After third sample year, assess whether recovery trajectory is acceptable and discuss whether pipe removal is preferred option

References

City of Bremerton (2014) Washington Avenue Beach Sewer Main Decommissioning Evaluation Report, November 2014 30pps

NOAA (2010)

WDNR Aquatic Lands (2015) Easement No. 51-092390 City of Bremerton Public Works Grantee, June 17, 2015, 29 pps.

Zar, J.H., (1999) *Biostatistical Analysis*, 4th edition, Prentice-Hall.